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SPAWNING OF PERCH IN ARTIFICIAL SPAWNING SITES OF THE NEST TYPE IN THE LOWER REACHES OF THE DNEPR

[Nerest sudaka na shtuchnikh nerestovshchakh tipu gnisd u ponizzi Dnipra]

by

M. D. Biliy

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In previous works (1950, 1952, 1954, 1958), we observed in certain places on the Vil'chanka river, perch spawning mainly in artificial nests. The investigations indicated that perch for the most part delay spawning on a sandy bottom. Spawning on a silted bottom is insignificant. In the spring, the pregnant perch remains in the Vil'chanka river channel, where in the presence of a suitable substrate it lays its spawn. If there is no substrate along the river channel, it travels as far as the coast. Spawning of perch is done first in the upper reaches of the Vil'chanka river, and then closer to the river's mouth. In the Vil'chanka river, the perch begins spawning at a temperature of 11° in places with a slow current or in its complete absence.

Let us consider the question of the places where perch spawn in

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the lower reaches of the Dnepr in artificial nests. In these parts of the river, we have made observations for five years of the spawning of perch and other fish in artificial nests, laid out in the bays of the Dnepr estuary, in the Ingulets river, and in certain flooded reservoirs (Krasnyukove, and Upper and Lower Solonets'k lakes, and so on). The results of these observations are presented below. Now let us pause over certain features of the bays of the Dnepr estuary.

Bakay bay is located on the left bank of the mouth of the Svinyachka tributary. Its entrance is three times as narrow as the bay itself.

The surface waters of the bay are 40-50% covered with drift, which is caused by washed-up roots of reeds, rushes, bulrushes, and other plants. In these bays, as in others, based on the data of I. Ya. Sirovatskiy (1929), V.I. Vladimirov (1955), and P.G. Sukhoyvan (1956), perch spawn. In order to study the question of the time at which the greatest perch spawning occurs, artificial nests were set up in the estuary, bays, in flooded reservoirs, and other places. Observations of spawning in the nests indicated first of all that spawning begins in nests in the flooded reservoirs. Later spawn appears in the nests near the entrance to the bays, and last of all in nests laid out in the estuary.

For example, in the flooded areas of lake Krasnyukove in 1959, the first nests laid with perch spawn were displayed on the 21st of April, and in the estuary and near Sokolin island, only on the 1st of May. Therefore, in the lower reaches of the Dnepr, the same picture is observed as in the central part: spawning of perch is completed first in the upper reaches and later as close as possible to the river mouth. In analyzing these phenomena, we came to the conclusion that water temperature affects the spawning of perch in the central part of the Dnepr. Apaarently, this also clarifies the character of perch spawning in the lower Dnepr. The water heats up first in the flooded reservoirs, then in the approaches to the bay and later at the estuary itself. It is necessary, therefore, to note that if the temperature of the water in the estuary and flooded reservoirs reaches 11-13°, the pregnant perch do not spawn in the estuary, but go to the

bays or flooded reservoirs. The data on laying the nests is presented in Table 1.

From Table 1, it is evident that all the nests laid out in the bays (upper and middle regions) were left vacant, while almost all the others which stood at the entrance to the bay and in the open estuary were laid with perch spawn. In this connection, we removed the nests from the bays into the estaury not far from the entrance to the bay. Checking the nests on the 30th of April showed 18 of them laid with eggs. This confirms that at this time the perch in the bay itself had not spawned; instead they spawned in the estuary quite intensively. But this does not mean that the perch in the bay had not spawned at all. In May the eggs of the perch appeared in eight nests. Therefore, in the bay, the perch spawn appeared at different times with varied intensity.

Table 1

Laying of nests with eggs of perch in the region of Bakay Bay in 1954

1 Місце розташування гнізд	2 Кількість поставлених гнізд	3 Кількість засіяних гнізд	4 Засів гнізд (в %)
5 Тупик затоки	10	0	0
6 Середина затоки	6	0	0
7 Затока зразу після входу в неї	8	2	25
8 Вхід у затоку	6	3	50
9 Лиман від входу в затоку:			
10 за 10 м	4	3	75
» 50 »	7	5	71,4
» 100 »	7	6	85,7
» 150 »	6	3	50
» 200 »	8	5	62,5
» 250 »	7	4	57,1
» 300 »	4	0	0
» 100 »	7	6	85,7
» 500 »	30	4	13,3
» 2000 »	7	5	71,4
» 2000 »	5	3	60

Key: 1. Location of the nest

2. Number of established nests
3. Number of nests laid
4. Laying of nests (in %)
5. Cul-de-sac in bay
6. Middle of the bay
7. Bay just inside entrance
8. Entrance to bay
9. Estuary from entrance to bay
10. At 10 m

Let us pause now at the question of those very places in the estuary at the approaches to the bay where the perch spawn. In order to answer this, nests were laid out in different places in the estuary which border on Bakay and Vasil'kivs'k bays.

Bakay bay is connected with the Svinyachkaya tributary and the Bakay arm by canals through which the water finds it way into the bay, and then into the estuary. In the places where the water enters the estuary, like in the bay itself, the current is insignificant; this is well indicated in the estuary at a distance of 500 m from the bay. The water from the bay flows along a channel 30-50 m wide at the estuary. On the right side of the channel, there is a sand bank; on the left side, the bank is covered with a small lamina of silt with reeds and rushes. At this section of the estuary, we set up artificial nests so that part of them was located in the channel along which the water from the bay goes into the estuary and part in places laid out to the right and left of the channel. The results of observations are presented in Table 2.

It was verified that the perch lay the most eggs in nests located along the channel, because, as it appeared, the nests were especially frequently laid which were located in the middle of the channel, where there was the greatest depth and flow of water.

On April 22, 1954, the water temperature in the estuaries and bays leveled off at 12°, 65 nests were established in Bakay bay, and 35 at the entrance to the bay. A check of the nests on April 24 showed that no nest in the bay was laid with eggs, while in the approaches to the bay the nests were richly sown.

In the estuaries to the right and left of the channel, laying of the nests was insignificant.

Let us pause to consider the observations made in the region of

Zakil'kivs'k bay, which is located to the right of the Svinyachkaya tributary. The entrance to the bay equals its greatest width, and its length is four times less than its width.

Table 2

Nests laid with perch spawn in the estuary in the region of Bakay bay

1 Місце розташування гнізд	2 Кількість поставлених гнізд	3 Кількість засіяних гнізд	4 Засів гнізд (в %)
5 Жолоб Бакайської затоки	25	20	80
6 Мілина праворуч від жолоба	25	7	28
7 Мілина ліворуч від жолоба	25	3	12

Key:
1. Location of nest
2. Number of nests laid out
3. Number of nests sown
4. Sowing of nests (in %)
5. Channel of Bakay bay
6. Shallow water to the right of the channel
7. Shallow water to the left of the channel

Table 3

Nests laid with perch spawn in the region of Zakil'kivs'k bay

1 Місце розташування гнізд	2 Кількість поставлених гнізд	3 Кількість засіяних гнізд	4 Засів гнізд (в %)
5 Жолоб біля Васильківської затоки	50	40	86
6 Лиман, коса, ліворуч від жолоба	50	24	48
7 Васильківська затока, праворуч від жолоба	50	18	36

Key:
1-4. As in Table 2
5. Channel near Vasil'kivs'k bay
6. Estuary, bank, left of the channel
7. Vasil'kivs'k bay, right of the channel

The bottom of the bay is silted, but at the entrance to it, it is sandy. The main stream of the Svinyachkaya at the outlet into the estuary closes in to the entrance to the bay and creates a channel in which the rate of flow is 0.07-0.3 m/sec. The bottom of the channel was sandy. To the right of it is a sand bank.

From the data in Table 3, it is evident that in the region of this bay, as in Bakay bay, the perch spawn for the most part in nests located along the channel, where there is a high water flow and significant depth. At the entrance to the bay, like in the bay itself, the percentage of nest laying by perch is far smaller than in the channel

and sand bank estuaries. Having obtained these data, we decided to conduct similar observations in the estuary itself, where the river bed passes through the arm of Bakay. In the estuary at a distance of 2-2.5 km from Bakay bay, 75 artificial nests were set up: 25 in the channel and 50 to the right and left of the channel. Observations have indicated that here the greatest amount of spawning in nests occurs along the channel and significantly less to the right and left of it.

In making observations in 1957-1959 on nest laying by perch, we obtained data which confirm our conclusions:

1. The pregnant perch in the lower reaches of the Dnepr migrate along the flowing water to the spawning site, staying in this deep channel, along which the main stream of water flows. If the perch find a substrate in these places, then they spawn here. If there is no substrate, the perch leave to spawn in the sand banks. Therefore, the best spawning of perch in nests is observed where the pregnant fish find a substrate. Thus spawning is greater along the channel than in the sand banks.

2. In the beginning of the spawning period, the pregnant perch find suitable temperature conditions in the far regions of the bay and flooded reservoirs, where the water temperature at this period is higher than in the estuary or rivers.

3. In the last half of the spawning period, the perch spawn in nests which are generally not in bays or flooded reservoirs, but in the approaches to them, i.e. closer to the mouth of the river.

These conclusions came about from the data presented on perch spawning in the Vil' hanka river; in other words, the perch spawn in the same way in both the central regions of the Dnepr and its lower reaches.

Time, Duration, and Intensity of Perch Spawning in the Lower Reaches of the Dnepr.

Data on the beginning, end, and duration of perch spawning in the Dnepr in different years are given in Table 4.

As is evident from the data in Table 4, in all the years, in the

central and lower regions of the Dnepr, the beginning of perch spawning occurs for the most part in the second half of April. This is conditioned by the fact that at this time, warming of the water is observed to be greater, which aids spawning. Early spawning in perch in the lower Dnepr occurred in 1955 during the 1954-1958 period, when the earliest warming was observed, and the latest was in 1957, when by the first half of April there had been insignificant warming. Before April 21, the water temperature in the river has not exceeded 3-7° on the average. It must be noted that at various points along the lower Dnepr,

Table 4

Duration of perch spawning in the Dnepr

1 Район Дніпра	2 Роки спостережень	3 Початок нересту	4 Кінець нересту	5 Тривалість нересту (у добах)
6 Середина Дніпра	1935	20/IV	15/V	25
7 р. Вільшанка	1938	17/IV	25/V	38
8 Там же	1939	20/IV	22/V	32
» »	1945	23/IV	28/V	35
» »	1949	17/IV	15/V	28
» »	1950	15/IV	15/V	30
» »	1951	10/IV	5/V	25
» »	1952	19/IV	20/V	31
» »	1953	9/IV	8/V	29
9 Пониззя Дніпра	1954	18/IV	17/V	29
10 Там же	1955	11/IV	15/V	34
» »	1956	19/IV	26/V	37
» »	1957	25/IV	21/V	26
» »	1958	15/IV	28/V	43
» »	1959	21/IV	28/V	37

Key:
1. Region of the Dnepr
2. Year of observation
3. Beginning of spawning
4. End of spawning
5. Duration of spawning (in days)
6. Central Dnepr
7. Vil'chanka river
8. The same
9. Lower Dnepr
10. The same

Table 5

Weight of perch spawn in a single nest (in g)

1 Місце розташування гнізда	2 Роки спостереження	3 Максимальна вага ікри	4 Мінімальна вага ікри	5 Середня вага ікри
6 Бакайська затока	1959	1300	500	846
7 Збур'ївський лиман	1959	1800	60	457
8 Бакайська затока	1958	2600	300	1120
9 р. Інгулець	1958	1800	500	740

Key:
1. Location of nest
2. Year of observation
3. Maximum weight of spawn
4. Minimum weight of spawn
5. Mean weight of spawn
6. Bakay bay
7. Zbur'ivsk estuary
8. Bakay bay
9. Ingulets river

perch spawning begins at different times and its duration at various

points is also different. For example, in 1958 in lake Krasnyukove, perch spawning in nests laid out began April 15 and lasted until May 23. In the Lower Solonets'k, spawning began on May 4 and ended May 12, i.e. it lasted only eight days. In Bakay bay, the first nests spawned appeared on April 25, and spawning ended May 23. In the estuaries of Sokolin island, perch spawning lasted from May 16 to 23, i.e. eight days. Therefore, in different regions of the lower Dnepr, the duration of perch spawning is not uniform; this must be assumed during fish breeding in artificial nests.

In all, perch spawning in the Dnepr lasts from 25 to 43 days. The duration of perch spawning in the central Dnepr and its lower regions is the same. In both regions of the river, perch spawning is concluded in the second half of May. In the central Dnepr (Vil'chanka river), spawning lasts 31 days and in the lower Dnepr 34. In our own works (1954), we noted that in the Vil'chanka river, perch spawning begins at a water temperature of 9-11°. In the lower Dnepr during 1954-1958, perch spawning began at a water temperature of 8.6°. If we turn our attention to the fact that leading into the river, the water temperature is 3-4° lower than in the bays and flooded reservoirs where the perch spawn, then it follows that in the lower Dnepr, perch spawning begins at approximately the same temperature as in the central Dnepr.

The question of initiation of spawning of perch in different years may be answered by the results of investigations of nest spawning along the bottoms. The largest number of nests spawned in 1959 was in the period of May 7-10, and in 1957 between May 8 and 10. In other years, the same picture was observed. Not considering the fact that in different years the water temperature was not the same, initiation of spawning, as a rule, fell close to the first ten days of May. In the second half of May, intensity of perch spawning decreased and at the end of the month, spawning was completely over. This confirms our conclusions that initiation of spawning generally is not affected by the water temperature in the given period, but it is by the preparation of the pregnant fish for spawning, which is conditioned by many factors.

In the same year, at separate points in the lower Dnepr, initiation of spawning is completed at different times. In 1959 in Bakay and

Vasil'kivs'k bays, this period fell within May 11-18, but in the estuary near Sokolin island, it was May 12 and 13. Therefore, the results of observations of spawning at the same point may not be mechanically carried over to other points or large regions of the river, because this diminished the gathering of data and does not provide the possibility in the practice of fish raising of utilizing the results obtained.

Table 6

Overall amount of perch spawning in nests laid out at fish breeding points

1 Місце розташування гнізд	2 Вага ікри (в кг)	3 Кількість ікринок (в шт.)
4 р. Литвинка	59,22	36 834 840
5 Васильківська затока . .	145,50	90 501 000
6 Бакайська затока	76,99	47 885 292
7 Збур'ївський лиман . . .	81,22	50 516 352
8 Всього. . .	362,93	225 737 484

Key: 1. Location of nest
2. Weight of spawn (in g)
3. Number of eggs
4. Litvinka river
5. Vasil'kivs'k bay
6. Bakay bay
7. Zbur'ivs'k estuary
8. Total

Amount of Perch Spawn in the Nests

Table 5 presents data from calculations of the amounts of perch spawn in a single nest.

As is evident from Table 5, the amount of spawn in a single nest is between 60 and 2600 g, since in the same river, but at different points of nest location, the mean amount was not the same. In 1959 in Bakay bay, on the average in a single nest there were 846 g of spawn, and in Zbur'ivs'k estuary only 457 g. A similar picture was observed also at the same points in different years. Thus, in Bakay bay in 1959, mean spawn in a nest was 846 g and in 1958 1120 g. Such a difference is conditioned first of all by the age of the pregnant fish and their size.

The greater the size of the female, as a rule, the more spawn they lay. It is necessary to mention that the female perch do not lay the spawn in portions but all at once (Biliy, 1954, 1958).

Knowing the amount of spawn in a single nest and the number of nests laid, we have indicated the total amount of spawn laid in the nests. In Table 6, data are presented on the overall amount of perch spawn laid in a nest in the lower Dnepr in 1959 at fish breeding points.

On May 6, 1959, the proportion of perch spawn was calculated at different stages of development. These proportions for a calculation for 1 gram of spawn are

	Amount per gram
Eggs at the stage of beginning gastrulation	625
Eggs with a mobile embryo	655
Eggs in which motion is beginning in the embryo	630 (626)

On the average, there are 634 eggs in 1 gram of spawn.

In 1959 in the lower Dnepr at four fish breeding points, 363 kg of perch spawn were obtained, or 225 million eggs. The presence of a large amount of spawn in a single nest on such a small surface provides the opportunity of proposing that part of the spawn find their way beyond the nest boundaries and die. To answer these questions, we applied flooring, which served to catch the spawn which find their way beyond the bounds of the nest. Using wooden sticks 2.0-1.5 m in size, they were covered with fabric (cotton, satin, baize, mesh, sailcloth). The surface of such a flooring was usually fastened to the nest vertically or horizontally in relation to the nest. Nests with flooring were set in the flow areas of the reservoirs or where there was no flow at all.

One part of the nests with flooring was set up in the upper Bakay bay where there was no flow. Two nests were set up horizontally on flooring and two vertically. As a control, the usual nests without flooring were set up abreast of the experimental nests. We checked and washed all the nests every day, which yielded the opportunity to estab-

lish the time of nest spawning.

For the first eight days, all the experimental nests with flooring were laid by only one third of the perch, but the control was spawned during this period. To confirm the data obtained, we repeated this experiment. The picture is the same. This is explained by the fact that the pregnant perch appeared to spawn more willingly in experimental nests than in the control. It must be allowed that in places where the nests are set out, the soil was slightly silted. In a previous work (Biliy, 1954), we noted that the pregnant perch wash the substrate before laying the spawn. They did this in both the natural spawning grounds and the artificial nests. It may be proposed that at the time of washing the nests set up on flooring, where the soil was covered with a slimy layer, the water was not muddied, and the muddy water near the control nests drove the pregnant fish from the nest. This conclusion is confirmed by the fact that in certain control nests, the substrate was torn from the framework of the nest, which was observed during the preparation of the substrate by the pregnant fish, in order to lay the spawn. These nests were not laid with spawn. The nests with flooring were less silted, which aided them in being laid with spawn.

The first part of the experimental nests with flooring (6) were set up, as has already been noted, higher upstream, where there was no current at all. The flooring was of cotton, satin, and baize. In general, for the flooring, colored fabric without nap was used, from which the spawn could be scooped up with a knife without harming it. The results of laying these nests with spawn are presented in Table 7.

From the data in Table 7, it is evident that under conditions of no current during the laying of spawn by perch in the nest set horizontally, the spawn did not find their way out of the nest.

The laying of nests set up vertically on flooring was also checked. For a certain time after setting them up, it appeared that two of them were laid with perch spawn. In one nest, the spawn weighed 970 g and on the flooring only 12 g; in the other nest, 560 and 7.5 g respectively. In both nests, spawn were laid uniformly along the entire substrate of the nest. Therefore, this confirms that the female perch

Table 7

Weight of perch spawn (in g), which found their way out of the nests, under conditions of no current (during spawning in the roots of reeds)

1 № гнізда	2 Загальна вага висіяної ікри	3 Вага ікри, висіяної на гніздо	4 Вага ікри, що потрапила за межі гнізда		7 Кількість ікри поза гніздом (в %)
			5 на відстані 5—25 см від гнізда	6 на відстані 25—50 см від гнізда	
1	807	800	7	0	0,8
2	354	350	4	0	1,1
3	1106	1100	6	0	0,5
4	658	650	8	0	1,2

Key:
1. Number of nests
2. Overall weight of spawn laid
3. Weight of spawn laid in nest
4. Weight of spawn which found their way out of the nest
5. At a distance of 5-25 cm from the nest
6. At a distance of 25-50 cm from the nest
7. Amount of spawn outside the nest (in %)

laid the spawn in the nest set vertically in order for them to move in the bed of water, so that an insignificant amount of them escaped beyond the nest. Evidently the female, at the time of laying the spawn, is positioned not above the nest, but creeps along the substrate of the nest. Only on account of such movements does the spawn find its way onto the nest substrate and not on account of its boundaries.

At the time the spawn is laid, for a current rate of 0.1-0.2 m/sec (Table 8), only an insignificant amount of spawn finds its way beyond the nest. This is true, as is evident in the case of nest #3, when the female laid 70 g of spawn along the stream in front of the nest. As a consequence, of this, much spawn did not find its way onto the substrate of the nest. A similar picture is observed in other spawnings, but always beyond the bounds of the nest, the spawn was significantly less than in nest #3. The presence of spawn on the nest flooring can be explained by the fact that it is carried by the current, and in front of it only by the fact that the female, at the time of laying the spawn,

stood not over the nest but a little in front of it.

Table 8

Weight of perch spawn (in g), which found its way into the nest and at its boundaries under conditions of flowing water (during spawning in the roots of willows)

1 № гнізда	2 Загальна вага висіяної ікри	3 Вага ікри на гнізді	4 Вага ікри на підстилці на відстані 25 см від гнізда				9 Кількість ікри поза гніздом (в %)
			5 перед гніздом	6 за гніздом	7 праворуч від гнізда	8 ліворуч від гнізда	
1	619	600	7	12	—	—	3,1
2	762	730	4	23	2	3	4,3
3	1275	1200	70	5	—	—	6,2
4	1023	1000	8	15	—	—	2,2
5	255	250	3	2	—	—	2,0
6	183	170	6	7	—	—	7,0

Key:
1. Nest number
2. Total weight of spawn laid
3. Weight of spawn in nest
4. Weight of spawn on flooring at a distance of 25 cm from the nest
5. In front of the nest
6. Behind the nest
7. To the right of the nest
8. To the left of the nest
9. Amount of spawn behind the nest (in %)

In one of the works published (Biliy, 1950), we noted that the female perch, at the time of laying the spawn, stand above the nest, so that its sexual opening is located against the center of the nest, where the most spawn falls. It appears that this is not always so; there are cases in which the female, in laying the spawn, stand a little to one side of the nest. Therefore, under these conditions, very little spawn finds its way out of the nest. For example, with 1205 g of spawn laid, only 5 g was carried to the stream outside the nest. In another

case with 1015 g of spawn laid, only 15 g were carried by the stream onto the flooring. This confirms that the female perch, in laying the spawn, is positioned on the nest so that its spawn can find its way into the stream only in the substrate of the nest. Probably the female, in laying the spawn, touches the substrate with its stomach. In such a position, it does not make strong movements with its tail, because otherwise the spawn laid would be much greater than is observed at the time of spawning in the nests. This is verified by the absence of the spawn on the flooring, where the nests are. Of the 6 cases, only one (nest #2) occurred in which the spawn appeared along the sides of the nest. In all the other cases, it was not observed, although there were 250-1200 g of spawn in the nests.

Having obtained this data on laying spawn in the nests, we decided to clarify under what conditions the female perch lays spawn in a small area of the nest. In order to do this, we prepared rectangular nests 2 X 1.5 m in size and set it them in an area with flowing and nonflowing water. Part of these nests were laid with bream and perch spawn. Spawn laying in them was the same as in ordinary round nests. In an area of 1.5 m^2, the females laid the spawn in each nest in a circle 40-60 cm in diameter. The rest of the substrate of the rectangular mests were free of spawn. This was observed in all the nests. Therefore, the female perch, in the presence of a large amount of substrate, lays the spawn in a circle, i.e. in both natural spawning areas and in small, round nests. It is difficult to say what practical significance laying spawn has in a limited space in the presence of a large amount of substrate. Possibly concentration of the spawn aids their burial by the female in the small volume of water near it. Further studies will yield answers on this questions.

In studying the question of the nature of laying perch spawn in the case in which the substrate appears not as an entire circle but is divided into sections, a case which is not observed in nature, special nests were prepared. The framework of these nests was covered with fabric underneath, which catches the spawn, which are found not on the substrate but between its separate points located under the flooring. Nests which 4-6 of such points were set up at the approaches to Bakay

and Vasil'kivs'k bays and stood horizontally on the bottom. After a certain time they were laid with perch spawn.

Studying of the substrate of these nests indicated that in one nest, two points out of four were laid with perch spawn, and the remaining two appeared to be empty. In another nest with four points, only one was laid with spawn, and the remaining three were not. There were no spawn on the flooring between the points, i.e. scattering of spawn was not observed, even while laying it at separate small points. It is important to say what the aim of such behavior is on the part of the female perch, because laying the spawn in a sufficiently separate space leads to a worsening of the conditions for spawn development. Therefore, on the whole, it is evident that the female perch, in laying the spawn in the nests, does not make various movements which would lead to scattering of the spawn on different sides, but on the contrary, by means of its own movements, it insures the laying of spawn over a limited surface.

It is probable that the female, at the moment of laying the spawn, is standing, not moving, in one place. This is confirmed by observations of the dropping of spawn in a bed of water. It is established that after 15-17 seconds the female is empty and the spawn extends for 23 cm. Therefore, the spawn in the water sinks to the bottom at a rate of 1.35-1.53 cm per second. The current flow in places where the nests are laid, as has already been noted, was no more than 0.2 m/sec. In such a current, the spawn laid can find their way onto the substrate of the nest only when the female lets it fall from a height of no more than 3-5 cm. The spawn, at an extent of 3-5 cm in a current flow of 0.3 m/sec for 2 seconds, are carried from the point of the drop 60-70 cm from the nest. If we consider that the diameter of our nests is 40-60 cm, then it follows that in dropping the spawn in the middle of the nest from a height of 3-5 cm, they would not fall within the nest, but beyond it. The studies indicate that outside of the nest, there is no spawn. It follows that at the time of laying the spawn, the female only touches the substrate with her stomach, and does not rise high above the nest. Only in such a situation are the females able to drop the spawn onto the nest substrate.

Usually, distinguishing the fertilized spawn from the unfertilized is difficult. In order to do this, we took part of the spawn from fe-

males with flowing spawn and fertilized it by the dry method; part of the spawn was left unfertilized. Then this spawn was laid on the nest substrate. After two days the unfertilized spawn grew white and became opaque. From this indication, we were later able to tell the fertilized spawn from the unfertilized. On the second day after laying the spawn, we could already calculate the amount of fertilized and unfertilized (pale) eggs (Table 9).

As is evident from Table 9, in Bakay bay and the Zbur'ivs'k estuary, where the water i not flowing, the unfertilized spawn was 0.8-2.5%. Another picture is observed near Vasil'kivs'k bay (channel), where the flow rate reached 0.1 m/sec; here the unfertilized spawn was greater (3.8-5.3%). Therefore, where the water flow is greater, the fertilization of perch spawn is lower. This is perhaps explained by the fact that

Table 9

Fertilization of spawn in nests

1 № гнізда	2 Місце розташування гнізда	3 Кількість проглянутих ікринок (в шт.)	4 Кількість незапліднених ікри (в %)
	5 При проточній воді		
1	6 Бакайська затока	320	1,1
2	» »	170	0,9
3	» »	160	1,0
4	» »	193	0,8
5	7 Збур'ївський лиман	207	1,2
6	» »	286	2,0
7	» »	317	2,5
	8 При швидкості течії 0,1 м/сек		
8	9 Васильківська затока, жолоб	511	3,8
9	» »	425	4,1
10	» »	315	4,2
11	» »	215	4,6
12	» »	283	5,0
13	» »	196	5,3

Key: 1. Nest number
2. Place where nest was laid out
3. Amount of transparent eggs
4. Amount of unfertilized spawn (in %)
5. In flowing water
6. Bakay bay

7. Zbur'ivs'k estuary
8. At a current rate of 0.1 m/sec
9. Vasil'kivs'k bay, channel

the current carries more sperm beyond the bounds of the nest. We encountered nests with a large amount of white (unfertilized) spawn. In some nests such spawn was 10-25%.

We studied the lack of perch spawn fertilization in the Vil' hanka river. Nonfertilization of spawn varied here between 1 and 5%. Having obtained these data, we decided to distinguish the percentage of nonfertilization of perch spawn during its artificial fertilization. For this spawn, from a female with flowing spawn, we fertilized with the milk of males from the places of the females. An artificial spawn was laid in nests which were where the nests laid by the same fish were.

A check indicated that in the study the unfertilized spawn was 27-63%. It follows that artificial fertilization of perch spawn by the dry method yields worse results in comparison with fertilization of the spawn by the fish itself. Therefore, in the practice of fish breeding, artificial nests must be used. It is also worthwhile to note that in laying an artificially fertilized spawn on the substrate of the nest, clods are formed which are significantly less, if the female lays the spawn. The formation of such clods aids the departure of the spawn at incubation.

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